

EFun:the Plume Sampling System for Enceladus

Completed Technology Project (2016 - 2018)



Project Introduction

Missions to Enceladus that want to determine the habitability of its icy ocean and search for extant life must acquire a pristine sample of the Enceladus ocean brine. The missions can either be accomplished via a lander or flythroughs of the plumes. From the mission and flight system design perspective, flythroughs incur less risk. Also, the planetary protection requirements are easier to meet. One of the key challenges for these missions is to avoid ambiguity of results that has plagued previous astrobiological efforts (e.g. Viking). Therefore, the system must collect a large enough sample to enable analysis by several independent techniques. In addition, the sample collection process must not alter or contaminate the sample, which can skew the analysis. The reliability of the collector after a long cruise time, its cleanliness and low mass are also key concerns. The goal of this proposal is to mature a sample collection mechanism to obtain a pristine sample of the ocean water via multiple flythroughs of the Enceladus icy plumes. The requirements for the sample collector include a large collector area to acquire the most sample while ensuring that it is efficiently transferred into a very small holding volume. It must preserve the sample in its pristine ice form until the instruments are ready to perform analysis and then efficiently transfer the sample to the downstream instruments. EFun is a square meter, <2kg funnel shaped collector that was designed as part of JHU/APL internal development, achieving TRL 3. As the icy particles enter the collector area, they are guided into a small holding volume. Once the ice is in the holder, EFun transforms the sample into liquid, prepares it by controlled dilution, and employs a syringe-like piston to distribute the sample to the instruments. A smaller version of the collector front end was prototyped and tested at NASA Ames vertical gun facility in vacuum and at temperature. These test have proven the integrity of the sample and characterized its collecting efficiency. Under ColdTech, we propose to prototype and test the holding volume of the collector and the sample preparation steps of melting, dilution, and transfer to downstream instruments. The goal is the development of a highly efficient and reliable system. This prototype will then be integrated with the large area collector and be tested as a complete system at Ames over the full range of expected plume environments. We will demonstrate end-to-end sample acquisition, liquefaction, and distribution. In addition, we would design a door mechanism to keep the collector area clean during the cruise. At the end of ColdTech, EFun would achieve TRL 5 and be ready to be proposed in upcoming missions.

Anticipated Benefits

The technology will benefit our ability to acquire samples from ocean worlds like Europa and Enceladus



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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Responsible Program:

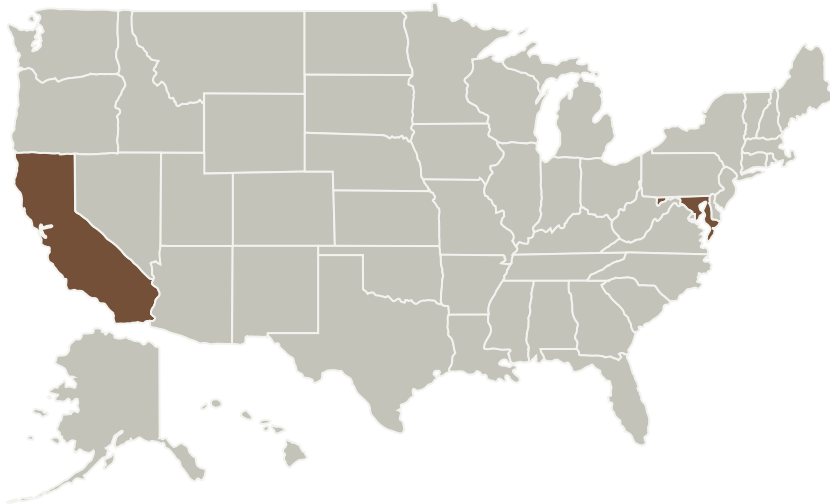
Concepts for Ocean Worlds Life Detection Technology

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Johns Hopkins University	Supporting Organization	Academia	Baltimore, Maryland

Primary U.S. Work Locations	
California	Maryland

Project Management

Program Director:

Carolyn R Mercer

Program Manager:

Carolyn R Mercer

Principal Investigator:

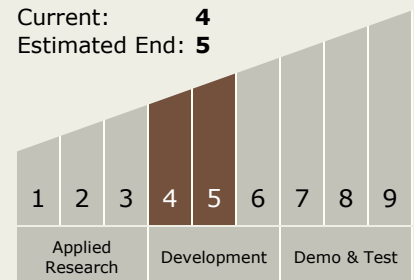
Elena Adams

Co-Investigators:

Jacob M Eisig
Ralph D Lorenz
Antonio J Ricco
David Willson
Melissa Guzman
Dana M Hurley
Christopher P McKay
Robert E Gold

Technology Maturity (TRL)

Start: 4
Current: 4
Estimated End: 5



Technology Areas

Primary:

- TX08 Sensors and Instruments

Continued on following page.



Technology Areas (cont.)

- └ TX08.3 In-Situ
Instruments and Sensors
- └ TX08.3.4 Environment
Sensors

Target Destination

Others Inside the Solar System